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ABSTRACT

This guide deals with the use of computer technology with students who have moderate cognitive abilities. It defines moderate mental retardation and notes the decreasing incidence of mental retardation. It describes characteristics of students with moderate cognitive abilities and examines the role of technology in the educational program of these students. The importance of relating technology applications directly to students' educational objectives is noted. Training on "daily use/low-tech" devices, such as copy machines, calculators, and answering machines, is described as increasing these individuals' skills for independence, employability, and leisure activities. Suggestions are offered for using certain technological devices such as camcorders and educational software as an intervention strategy to achieve students' educational goals. Guidelines are presented for achieving an effective match between the learner and the technology, for selecting software, for determining necessary keyboard adaptations, and for making use of emerging technologies. The guide concludes with a list of organizational, periodical, and product resources. (JDD)

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ED 339159

Center for Special Education Technology

Tech Use Guide

Using Computer Technology

Students With Moderate Cognitive Abilities

Moderate mental retardation is defined by the American Association on Mental Retardation as occurring within an IQ range of 35 to 55 and existing concurrently with deficits in adaptive behavior (Grossman, 1983). Adaptive behavior refers to an individual's adjustments to tasks of everyday living. Deficits may be observed in communication skills, socialization, academic learning, and vocational competence and vary from child to child. This condition may have an organic, genetic, or traumatic etiology. Examples include individuals with Down's syndrome, seizure disorders, cerebral palsy, and autism. However, treatment and educational programming are not typically related to etiology, but rather to the individual's functional level and learning style.

During the 1988-89 school year, just over a half million of the students (ages 6-17) served in special education were classified as mentally retarded. The number of students served in this high-incidence handicapping condition has declined steadily over the last 15 years. The decrease has averaged 3% a year since 1976 with an overall decrease of 36%. While there has been considerable speculation about the reasons for the decrease, as yet no data are available to substantiate any hypothesis. The 1990 Amendments to EHA authorized a special study to examine the factors that have contributed to the decline in the number of children classified as mentally retarded.

Characteristics of Students with Moderate Cognitive Abilities

Considerable variability exists within this population of children with moderate cognitive abilities. Depending on the extent of involvement, individuals will exhibit varying levels of maturation, academic achievement, and social and vocational adequacy. Curriculum may emphasize communication skills, social skills, self-help skills, motor development, coping successfully with the physical environment, functional academics, and daily living skills.

Children with moderate mental disabilities exhibit a wide range of academic achievements. To varying degrees, they learn to tell time, count money, and use a calculator. By adulthood, some individuals can count or match to sample while others have an understanding of basic addition, subtraction, and occasionally multiplication. Typically, these students read at first or second grade levels with limited comprehension. They do, however, develop functional reading skills such as reading signs, simple forms, and menus. Within this group, considerable variability in written communication exists. Some must use stamps to affix their signature while others can write thank you notes, shopping lists, and simple news articles. The diversity of achievement levels among individuals with moderate mental handicaps may be attributed to a combination of individual differences as well as to the influence of society's low expectations.

Since acquisition, transfer, and generalization of skills and knowledge are difficult for individuals with moderate cognitive impairments, instruction is provided in domestic, vocational, and leisure skills. By late adolescence most moderately disabled individuals can perform basic self-care tasks and many household chores with supervision. Although, historically, this is the group of people who have worked in a sheltered workshop, many are able to work in supported employment if their behaviors and physical disabilities do not inhibit or preclude their participation. Many have difficulty in selecting and engaging in leisure activities without some instruction or guidance and must be taught how to use their time in a productive manner. Most can perform simple games and participate in activities that are moderately competitive, require limited motor skills, and are cognitively and chronologically appropriate.

Although communication skills vary, most communicate using limited speech and language. By the time they reach adolescence, many speak in short sentences and can follow two- and three-step directions. Most are capable of communicating their essential needs, but not always clearly. A portion of this population has severe communication deficits and must rely on alternate forms of communication that augment or take the place of oral speech.

Devices used range from sign language and homemade communication boards, to simple electronic devices, to highly sophisticated voice output communication aids (VOCA) such as the *TouchTalker* and the *Wolf*.

Typically, students with moderate mental retardation are educated in special day classes, often in special schools. However, increasingly, they are placed in regular schools with some time spent in regular education classrooms. This changing philosophy toward the integration of students has affected the desired outcomes for these students. Today, more than in the past, educational goals are directed toward optimizing independence for these students and readying them for supervised or semi-independent living and working environments.

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Technology in the Education Program

The world for which these youngsters need to be prepared differs greatly from that of a few years ago. The vast array of technological devices that permeate all levels of society necessitate a change in the instructional content for all students. The technological devices span a continuum from "daily use/low-tech" (e.g., microwave ovens, calculators, and VCR's) to "high-tech" devices such as computers. In the education of individuals with moderate mental disabilities, the new technologies present several challenges:

- Which technologies and/or devices should these students be taught to use?
- How can technology be used instructionally to enhance the learning process?
- How can technology serve as a prosthetic device?

The content of this guide addresses these questions. It is based to a large extent on promising practices and the work of experienced educators as little empirical support exists in the literature at this time. Future research efforts are needed to explore the relative contribution of technology within an otherwise effective educational program. Students with moderate cognitive abilities are functioning in a technology rich environment which must be taken into account when preparing them for productive, fulfilling lives.

When choosing to use technology, the principles of effective teaching must be applied. The goal of the instruction must be clearly established. The context in which the instruction will occur must be well planned. Who provides the instruction and the level of technological and instructional expertise of that individual must be considered. Finally, the technology must be evaluated for its appropriateness to the characteristics of the learner and for how directly it correlates with the purpose of the instruction.

Goals of Education

The outcomes of education for students with moderate mental retardation span the cognitive and affective domains. Such outcomes often include the independent functioning skills necessary to live in the community and secure vocational training or employment. Specific outcomes may include:

- Develop communication skills.
- Increase independence.
- Engage in recreational activities.
- Interact socially.
- Become employable.
- Control their environment.
- Maximize their potential for living productive and happy lives.

Whether a technology application involves training for use of a household appliance such as a microwave oven or training for use of a computer to assist in academic instruction, it must be directly related to one of these goals. Figure 1 suggests guidelines to follow when planning to use technology in the program of instruction.

The technology can be organized according to the functions it performs in the lives of people with moderate mental retardation at home, in school, and in the community. Knowledge and understanding of some devices is necessary for life skills, for quality of life, and for communication. Other pieces of equipment can be effective learning tools for students as well as instructional tools for teachers. Finally, technologies that are not yet commercially available need to be considered as potential life-enhancing devices for members of this community.

It is essential to note that instruction for individuals with moderate mental retardation should include extensive supervision by professionals, paraprofessionals, and parents. Intensive tutoring and adult intervention should

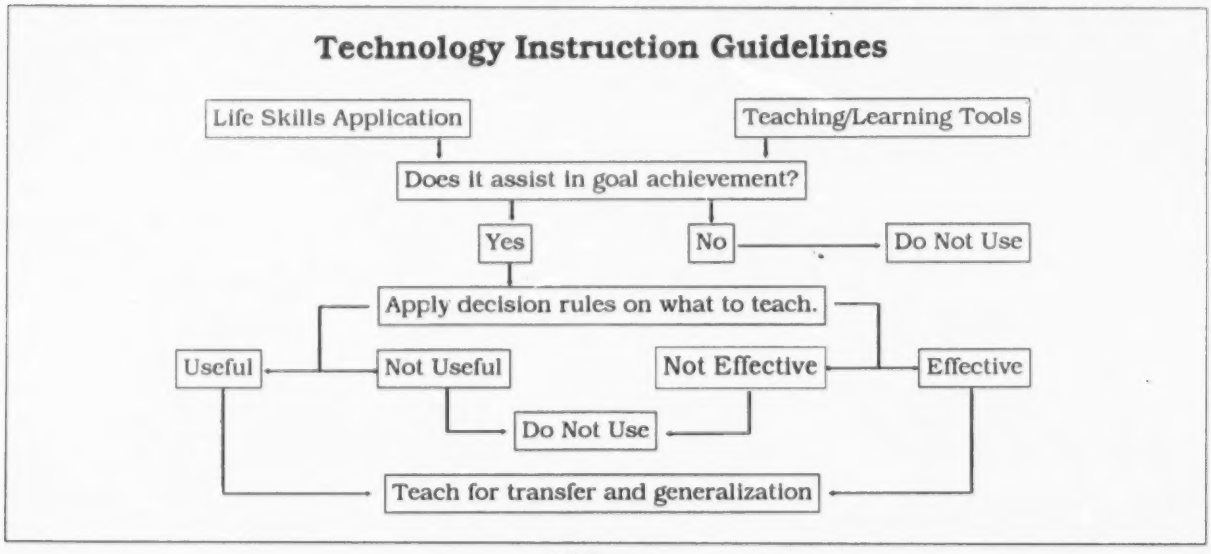

Figure 1

continue for 24 hours each day and should occur in each of the child's environments. These adults must be trained properly to implement technology-based interventions. Furthermore, the instructional applications for the students may have applications for the professionals, paraprofessionals, and parents. Applying technology to train parents, teachers, and caretakers may be the most cost-effective and far-reaching use of computers, VCR's, videodisc players, and other devices.

Life Skills

Much of the technology applicable for life skills is available at the consumer level. The ability to use these "daily use/low-tech" items will increase these individuals' skills for independence, employability, and leisure activities.

Some of the devices are:

- Answering machines
- Auto dialers
- Automatic teller machines
- Bar code readers
- Beepers
- Calculators
- Camcorders
- Clothes dryers
- Clothes washers
- Computer software: games and graphics
- Copy machines
- Debit cards
- Dishwashers
- Environmental controls: air conditioners and thermostats
- Fax machines
- Microwave ovens
- *Nintendo*
- Remote controls
- Slide projector
- Small appliances
- Stereos
- Tape recorders
- Telephones
- Telephone auto dialers
- Televisions
- VCRs
- Vending machines
- Voice mail

Each student with moderate disabilities has a unique set of learning characteristics. Consequently, service providers need to be thoroughly familiar with a wide repertoire of educational techniques and strategies. This axiom applies to instruction with and about daily use/low-tech devices. Each piece of equipment needs to be evaluated with an analysis of the discrete skills required to understand its function and to operate it. These skills must be placed in a hierarchical order and taught to the student in an ascending sequence. Each student must then be assessed about which, if any, of the skills he/she knows and which he/she needs to learn.

The context in which the instruction takes place must move gradually from the classroom setting to the daily living environment. Parents and caregivers should become familiar with the instruction about technology so that they will support its use in other environments. Students need instruction in all settings. If the skills learned about one device can be transferred to another, specific transfer instruction must be given. Before, during, and after the instruction, the student must experience the application for which the device is being taught.

For many of these youngsters, the technology will be used to enhance their quality of life. While using a remote control may not be an important life skill, being able to turn the TV on and off and changing channels independently are important life-enhancing activities. In addition, many children with moderate mental retardation can use these devices as vehicles or facilitators for social interaction. If parents, teachers, and paraprofessionals structure the students' activities around using these devices, a setting for social interaction can be created. With this setting, these children may develop and improve their social interactive skills.

Learning Tools

Many of the devices just listed can be used by youngsters with moderate mental disabilities to enhance their learning of other skills. Although each application of computers and related technologies is specific to the individual, general guidelines can be followed. First, think not about what works well with the student, but rather about what is not working, and consider using technology as an intervention strategy. Assess the relationship of the use of technology to the established educational goals. Assess the student's degree of independence with the learning task and consider if using technology will increase or decrease this independence. Place the use of the electronic device within the continuum of instruction making sure that pre- and post-computer activities are included. Plan for consistency between the home and the classroom environments so that youngsters are trained to use equipment found in both places. Include the use of technology in the IEP process so that families participate in planning for their children to use technological devices. Continue communicating with the families throughout the process of enabling these individuals to become technologically functional. Finally, remember to consider all varieties of electronic devices, the relationship to the user's present and future life, and that sometimes it may not be appropriate to teach with, about, or how to use an electronic device. Devices that can be used as tools for learning are:

- Audiotapes
- Calculators
- Camcorders
- Cameras
- Computers
- Debit and credit cards
- Educational software that enhances:
  1. Receptive and expressive language skills
  2. Reading, math, speech
  3. Written expression
  4. Memory
  5. Creative expression
  6. Ability to monitor behavior
  7. Self-esteem
  8. Eye-hand coordination and fine motor skills
  9. Spatial concepts
  10. Sequencing and turn taking

- Graphics programs
- Slide projectors
- Software to develop speech and language
- Televisions
- Videotapes
- Voice recognition systems

Guidelines for Technology

Decisions about using technology with moderately disabled students should not be made lightly. Efforts must be made to examine the particular learner's abilities, chronological and mental ages, educational goals, as well as the capabilities of the technology. The following are guidelines to be used when trying to achieve an effective match between the learner and the technology.

- In what way(s) can the instructional goal(s) be met without technology?
- Can technology enhance achievement of the goal(s)?
- Is the technology and its use age-appropriate?
- Where does the use of technology fit in the continuum of instruction, the IEP, and the curriculum?
- What instructional strategy(ies) will be used with the technology?
- In what way does the technology match the student's learning style, access needs, as well as social and self-esteem needs?
- Does the use of technology supplement or supplant other instruction?
- Will the use of technology become an isolated activity?
- Does the use of technology and the selected instructional strategy(ies) place the learner in a passive role or in a role in which he/she initiates action?
- Is the amount of adult supervision and assistance needed for the learner to use the technology consistent with the significance of the learner outcome(s)?
- Can the learner use the technology in the home and the community as well as in school?
- Can parents and siblings participate in using the technology with the learner?

In schools, the computer is frequently used to enhance the learning process. Since cognition is probably the single greatest barrier for students with moderate cognitive disabilities, instructional software designed for teaching reading, math, language, and other academic skills must be examined carefully to see if it incorporates sound instructional design principles, such as ease of use, clarity of purpose, simulation of real-life experiences, and a logical sequential progression from one level to the next.

The Computer as an Instructional Tool. Students with moderate mental retardation often acquire the needed prerequisite skills much later than other students. For example, students with Downs syndrome, who were written off as academic failures in elementary school, may learn to read independently in their late teens and early twenties, if given the opportunity. Because technology often provides a replicable instructional package, and a high level of portability and individualization, technologically-assisted instruction may provide these students with a second and successful chance in important skill areas.

Certainly, word processing should be taught to these students. Word processing software and the computer with which to use it need to be chosen carefully so that the student's unique needs are met. Each will use it according to her/his abilities in written communication. If the child can learn to use the QWERTY keyboard and the functions of the word processor, his or her employment possibilities will be increased. Even without using the keyboard, word lists and form letters saved as data files can be retrieved and the student, by using a mouse, can pick and choose the words needed for the list, written message, or letter.

Familiarity with the QWERTY keyboard can be taught by using commercially available software which is self-pacing and keeps records. Keyboarding can be defined as familiarity with the placement of the letters on the keyboard so that "keying" in text is done at the same or faster rate than if the child wrote by hand. Software used for keyboarding should introduce the keyboard, regulate the number of keys introduced at a time, and gradually increase the rate of "keying." The team of teachers, occupational therapists, and parents should jointly monitor the child's progress while using the computer and noncomputer activities to strengthen finger movements needed for using the keyboard. If the individual learns to use the keyboard, simple data entry activities should be tried. Routine data entry tasks may be performed in a real or sheltered work setting.

Graphics software that enables the child to create drawings, as well as software with preprepared graphics, will allow the child to be creative and explore shapes, forms, and colors. The use of graphics programs on the computer encourages students to make an unlimited number of creative decisions. Decisions are made in a safe way because the "undo" icon easily allows changes to be made. Within the school, graphics software can be used as an instructional activity in art or language development. Outside of school, it can be used as a structured recreational activity.

Software Selection

A note of caution must be given when using the computer as an instructional tool with children with moderate mental disabilities. Not much research exists in this area, and what has been done is limited and not yet replicated. However, it is known that students with moderate cognitive abilities need consistent and prolonged practice before they master a skill. The skills they practice with the software may not transfer to noncomputer activities. However, for rote reinforcement of already learned concepts, drill and practice software created with an appropriate instructional design may have an application. Before investing in an instructional software, consider the following questions:

Content:

- Is it age appropriate?

- Is reading required? How much? At what level? Can it be skipped? Are the sentence structure and vocabulary too complex?
- Is it broken down into discrete skills that are presented in an ascending sequence?
- Are there gaps in the instructional presentation?
- Does it simulate the real-life use of the skill(s) presented?
- Can it be used in the school, home, and community?
- Does it project values consistent with the individual, family, and school?
- Is it interesting and motivating to the child?
- Does it have authoring capabilities so that it can be individualized?
- How does the program deal with incorrect responses?
- With what degree of independence can the learner use the program?

Speed:

- Does the program move on its own?
- Can the speed be controlled by the user? Must the teacher adjust the speed? Can the time constraints be removed?

Sound:

- Is it appropriate?
- Does it have a meaning within the program? Does the student understand the purpose of the sound?
- Is it reinforcing or distracting to the learner?
- Can it be turned off by the user? Must the teacher turn it off?

Speech:

- Is there voice output?
- Is the quality good?
- Is the vocabulary at the individual's level?
- Is the text easy to read and well formatted?

Graphics:

- Are they age appropriate? Is it clear what they represent?
- Is their relationship to the content clearly understood by the learner?
- Can the user modify them? Can they be removed?
- Are they reinforcing or distracting to the learner? Is the color a reinforcer or distractor?

Software response/reinforcement:

- Is it understood by the user?
- Is it reinforcing to the learner? Exactly what learner behavior is being reinforced?
- Does it have data collection capabilities?

Keyboard Adaptations. The computer system was developed for the average adult—the individual with good reading, fine motor, and visual skills. If a student's abilities are not at the average adult level in any one of these areas, adaptations may be needed to tap the power of the computer. Several simple strategies exist that give students access to the keyboard when motor and reading abilities hamper normal use. For the student with motor impairments, adaptations to the existing keyboard can be made or an alternate keyboard can be used. Keyboard adaptations can include physically altering keyboard features such as the repeat key function for students with heavier and slower typing skills. If they tend to hit two keys at once, a keyguard can be set on top of the keyboard. This plastic device has individual finger holes drilled in it, providing access to only one key per finger. For the student using a program requiring only a few keys, stickers with colors or pictures can be placed on the target keys, drawing attention to only the relevant keys. Molded flexible plastic keyboard overlays can be used to cover the keys and large letter stickers can be placed on the "covered" keys. Input devices such as mice, turbo balls, single switches, and touch windows may be used with most computers and with specific software. These "simple fix" strategies are endless, easy, and inexpensive to implement.

When simple fixes still do not provide the student with adequate access to the computer, alternative keyboards become an option. These devices come in a variety of shapes and sizes and require different motor and reading skills. Programmable keyboards allow students to access customized keyboards with overlays displaying pictures, symbols, and/or words designed specifically for that student. These keyboards are commercially available; finding the appropriate device is essential to the student's successful use of the computer.

Software with Voice Output. Customarily, computer output is visual and appears on the screen and printer. For many students, however, auditory output greatly increases their ability to attend to the activity. With increasing frequency, programs are being published with a speech output component. The speech may be in the form of instructions or comments to the user, as a part of the dialogue of characters, or may be a reciting of letters, words, and paragraphs typed by the student. Speech output can be synthesized or digitized. The former sounds robotic and the latter, human-like. The speech can be male or female, and the pitch and volume can sometimes be controlled. Although the research does not decisively conclude that software with voice output increases learner outcomes, practitioners report many student successes when software with voice output was used as an instructional strategy.

How the student accesses the technology is directly related to the way in which he/she is positioned by the equipment. The monitor must be at eye level, the child must be comfortably seated in a position that does not encourage fatigue, and the keyboard or alternate input device should be within easy reach. In order to ensure that the student is positioned correctly for the technology in use, the occupational and physical therapists, teacher, paraprofessionals, and parents need to work together. The positioning of the child should be monitored and adjusted according to the device being used, the setting in which it is used, and the child's growth and development.

Noncomputer Devices. Devices other than the computer can be used to enhance the learning process. Filmstrips, slide projectors, still pictures, and videotapes can be used with this population in the same ways as with other students. In addition, these children can photograph themselves and their environment and become producers of their own instructional material. They can create audio/videotapes and share them with others in the manner of "pen pals." Some of the children may be able to operate the equipment while others are being filmed and/or recorded. Many activities encouraging communication can be developed with these electronic devices. Both audio and videotape can be used as a visual and auditory record-keeping system of a student's progress. By sharing tapes among home, work, and school, parents, teachers, paraprofessionals, and related service providers can become familiar with what the child does in each of his/her environments. Communication among the adults in each setting will facilitate an integrated and comprehensive educational approach for the child.

Calculators can be used to do the arithmetic needed for daily living skills. Calculators with printed tapes can be used to make the functioning of the device less abstract as well as checking to see if the correct numbers and operations have been entered. In order to increase the ability of these students to become semi-independent in skills requiring simple arithmetic, calculators should be taught along with the manipulative and pencil/paper skills of addition, subtraction, and multiplication. In this way youngsters' cognitive deficits will be less handicapping, as the calculator serves as a "cognitive prosthesis."

Debit cards can serve to enhance independence of young adults with moderate cognitive abilities. They enable the individual to shop at local stores. The difficulties of handling money correctly will be bypassed since both the cardholder and shopkeeper will know if there is enough money in the account for the items being purchased. Parents and caretakers will be able to oversee the living expenses of these students with greater ease. The young adults will have a greater sense of independence and self-esteem if they have the ability to make purchases for themselves.

Emerging Technologies

Emerging technologies hold great promise for students in this population. For example, voice recognition systems allow children to initiate activities by verbally commanding the system to turn on the TV, place a phone call, or dictate a shopping list. Voice recognition systems require the user to have consistent verbal utterances, but the sounds do not have to be intelligible to other humans because the device can be programmed for each specific sound. Although the voice recognition systems may not be available in the immediate future, for those individuals with adequate speech, they hold great promise.

Another emerging technology is the input device/keyboard that will translate illegible but consistent writing into messages. For the young moderately impaired child who cannot formulate letters or numbers, the device can be programmed to understand "scribble" and translate it into messages such as, "I love you Mommy and Daddy," to "I feel sick," or even produce a shopping list. With such an input device, these children no longer will have to be passive learners. They will be able to initiate actions, effect changes in their environments, and respond in a way that the "listener" can understand without playing "multiple guess."

Although multimedia materials exist for many student populations, it is considered an emerging technology for children with moderate cognitive abilities because no courseware has been developed specifically for their use nor is much of the commercially available material easily adaptable in its present form. However, authoring programs such as *HyperCard*, *HyperStudio*, and *Link Way* enable teachers to create multimedia lessons for students. As the computers, videodisc players, CD-Rom players, monitors, and other equipment needed for multimedia activities become more accessible in the schools, additional programs and uses should be developed. Since by nature, multimedia is an instructional tool that presents information in two or more modalities, it is a promising one for these children.

SUMMARY

If technology is put into the hands of students with moderate cognitive abilities, the reasons for doing so need to be well thought out. The technology should be used with these students when it will enable them to participate in life more fully than they would be able to without it. This principle applies to using technology both for life skills and for enhancing the learning process. In the latter case, care must be taken that the learning outcomes warrant the expense, time, and adult supervision that using the technology may require. In both instances, the principles of effective instruction must be applied. It is critical that parents, teachers, related service personnel, and caregivers in all of the child's environments share the goals for technology use and assist the child in its use in each setting.

In deciding which technology(ies) to teach and/or to teach with, four interrelated steps are suggested to guide decision making.

1. *Analyze.* Analyze the student's goals.
2. *Status Quo.* How can you use what you already have to accomplish this goal?
3. *Risk Taking—Future Needs.* What should be ordered and/or what staff development needs to be developed to accomplish the goal?
4. *Human Relations.* How can the selected technology enhance the child's present life at home, in the community, and at school?

CONCLUSION

While the profile of children with moderate cognitive abilities is likely to remain the same, the world in which they live will continue to change rapidly. New devices and new uses for existing technologies are being created every day. It is our responsibility as educators to explore ways in which this population can use new and existing technology in schools, homes, and work settings. New semi-independent or sheltered work environments should be designed with these youngsters performing routine tasks such as simple data entry, bar code scanning, label creating, and other similar activities. If we expect that people with moderate cognitive abilities will become technologically literate, then we will find the ways to enable them to do so. We need to do this so that their place in our society remains a useful one.

RESOURCES—ORGANIZATIONS

American Association on Mental Retardation, 1719 Kalorama Road NW, Washington, DC 20009.

The Council for Exceptional Children, 1920 Association Drive, Reston, VA 22091-1589.

International Society for Technology in Education (ISTE), 1787 Agate Street, Eugene, OR 97403-1923.

RESOURCES—PERIODICALS

The Computing Teacher, International Society for Technology in Education (ISTE), 1787 Agate Street, Eugene, OR 97403-1923.

Exceptional Children, The Council for Exceptional Children, 1920 Association Drive, Reston, VA 22091-1589.

Journal of Special Education Technology, Peabody College of Vanderbilt University, Box 328, Nashville, TN 37203.

Teaching Exceptional Children, The Council for Exceptional Children, 1920 Association Drive, Reston, VA 22091-1589.

Technology and Learning, Peter Li, Inc., 2451 E. River Road, Dayton, OH 45439.

RESOURCES—PRODUCTS

Touchtalker, Prentke Romich Company, 1022 Heyl Road, Wooster, OH 44691; 216/262-1984.

WOLF, Wayne County Intermediate School District, Attention: Greg Turner, 33500 Van Born Road, Wayne, MI 48184; 313/467-1415.

REFERENCE

Grossman, Herbert. (1983). *Classification in mental retardation*. Washington, DC: American Association on Mental Deficiency.

In February, 1991, the Center for Special Education Technology conducted a Seminar on Technology for Students with Moderate Disabilities. The content of this guide is based largely on the discussions during the seminar. Our thanks to the 10 participants for sharing their expertise:

- *Carrie Brown, Association for Retarded Citizens*
- *Harriet Copel, Lawrence Middle School*
- *Jean Fleischner, Columbia University*
- *Beverly Gerber, Southern Connecticut State University*
- *Jami Hays, University of Kansas*
- *Brenda Heiman, Albuquerque Public Schools*
- *Alan Hofmeister, Utah State University*
- *Frances Meyer, Cooke Foundation for Special Education*
- *Larry Sargent, Smouse School*
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Learning Disabilities
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Moderate Cognitive Abilities
Preschool Children
Planning Computer Lessons
Role of the Occupational & Physical Therapist
Role of the Speech Therapist
Selecting Software
Severe and Profound Disabilities
Speech Technologies
Technology for Work, Home, and Leisure
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Visual Impairments

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